

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-250853

(43)Date of publication of application : 17.09.1999

(51)Int.Cl.

H01J 43/02

H01J 43/28

(21)Application number : 10-049471

(71)Applicant : HAMAMATSU PHOTONICS KK

(22)Date of filing : 02.03.1998

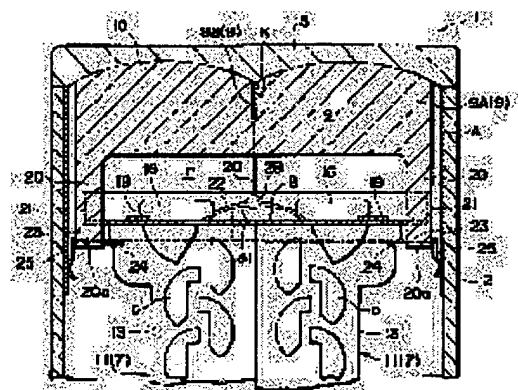
(72)Inventor : KIMURA SUENORI
MACHIDA KATSUHIKO
KUSHIMA HIROYUKI

(54) PHOTOMULTIPLIER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a photomultiplier of simple structure which is of a simple structure, which comprises a less number of part items, and which can be easily assembled.

SOLUTION: In a photomultiplier 1, a partition plate 9 is disposed to be adjacent to a convergence electrode plate 8 on it, where the convergence electrode plate 8 need be in an electrically contactless condition to the partition plate 9. In disposing the partition plate 9 in an electron convergence space S on the convergence electrode plate 8, therefore, a leg part 20 is provided on the partition plate 9, and the leg part 20 is inserted into a leg insertion part 21 provided in the convergence electrode plate 8 in a contactless condition, so the contactless condition between the convergence electrode plate 8 and the partition plate 9 is secured. The leg part 20 is fixed to a fixed electrode plate 22 fixed on a photomultiplier body 7, so the partition plate 9 is surely fixed in the electron convergence space S. By positively providing an opening part P between the partition plate 9 and the convergence electrode plate 8, an antimony bead 28 or the like necessary in a photoelectric surface forming process in assembling the photomultiplier 1 can be disposed in the opening part P.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the
examiner's decision of rejection or application converted
registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of
rejection][Date of requesting appeal against examiner's decision of
rejection]

*** NOTICES ***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] A dashboard is arranged in the electronic convergence space between the optical entrance windows and electronic multiplication objects which had the photoelectric surface inside. In the photomultiplier tube which divided said electronic convergence space into plurality with said dashboard, constituted two or more segments, and had the multiplication section for said every segment Opening which said dashboard is formed [opening] caudad and makes between said adjoining segments open for free passage in said electronic convergence space, The leg over which it was built between the fixed electrode plate made to fix to said electronic multiplication object, and said dashboard and said fixed electrode plate, The photomultiplier tube characterized by having made it fix to said electronic multiplication object, having been prepared in the convergence electrode plate arranged between said fixed electrode plates and said dashboards, and said convergence electrode plate, and having the foot insertion section which makes said leg penetrate in the state of non-contact.

[Claim 2] Said foot insertion section is the photomultiplier tube according to claim 1 characterized by being a slit or a hole.

[Claim 3] The photomultiplier tube according to claim 1 or 2 characterized by having arranged the source of vacuum evaporation for photoelectric-surface formation to just under said dashboard in said opening department of said dashboard.

[Claim 4] The photomultiplier tube according to claim 3 characterized by having arranged antimony BISU of said sources of vacuum evaporation at a part for the intersection of said dashboard.

[Translation done.]

*** NOTICES ***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DETAILED DESCRIPTION**[Detailed Description of the Invention]**

[0001]

[Field of the Invention] This invention relates to the photomultiplier tube and relates to the photomultiplier tube of the head ON mold especially divided into two or more segments.

[0002]

[Description of the Prior Art] Conventionally, there is JP,63-91950,A, JP,58-41617,B, JP,7-192686,A, JP,5-59539,B, or JP,63-261664,A as a technique of such a field. The photomultiplier tube indicated by these official reports has a dashboard between an optical entrance window and an electronic multiplication object, and is dividing it into two or more segments with the dashboard. The photomultiplier tube of such a multi-segment format is for arranging the multiplication section for every segment and deducing the location of the radiation sources, such as an X-ray and a gamma ray, with high degree of accuracy.

[0003]

[Problem(s) to be Solved by the Invention] However, since the conventional photomultiplier tube was constituted as mentioned above, the following technical problems existed.

[0004] Namely, with the dashboard, the conventional photomultiplier tube was constituted so that electronic convergence space might be completely divided for every segment, and it needed the convergence polar zone for two or more segments of every inside the photomultiplier tube. Therefore, while structure became complicated, the assembly man day also increased and there was a trouble of inviting a cost rise.

[0005] This invention was made in order to solve an above-mentioned technical problem, especially, is easy structure and aims at offering the photomultiplier tube which components mark tend to assemble few.

[0006]

[Means for Solving the Problem] The photomultiplier tube of this invention concerning claim 1 arranges a dashboard in the electronic convergence space between the optical entrance windows and electronic multiplication objects which had the photoelectric surface inside. In the photomultiplier tube which divided electronic convergence space into plurality with the dashboard, constituted two or more segments, and had the multiplication section for every segment Opening which a dashboard is formed [opening] caudad and makes between the adjoining segments open for free passage in electronic convergence space, The leg over which it was built between the fixed electrode plate made to fix to an electronic multiplication object, and a dashboard and a fixed electrode plate, It is characterized by having made it fix to an electronic multiplication object, having been prepared in the convergence electrode plate arranged between the fixed electrode plate and the dashboard, and the convergence electrode plate, and having the foot insertion section which makes the leg penetrate in the state of non-contact.

[0007] In this photomultiplier tube, a dashboard needs to be the photoelectric surface and this potential which were formed in the optical entrance window, on the other hand in order to carry out incidence of the convergence electrode plate, completing the electron emitted from the photoelectric surface as each multiplication circles, it needs potential higher than the electrical potential difference of the photoelectric surface. Consequently, in carrying out contiguity arrangement of the dashboard on a convergence electrode plate, it is required to change a convergence electrode plate and a dashboard into a non-contact condition electrically. Then, when arranging a dashboard in the electronic convergence space on a convergence electrode plate, the non-contact condition of a convergence electrode plate and a dashboard is secured by inserting the leg in the foot insertion circles which prepared the leg in the dashboard and were prepared in the convergence electrode plate in the state of non-contact. Moreover, a dashboard is made to certainly fix in electronic convergence space by making the leg fix to the fixed electrode plate fixed to the electronic multiplication object. If such a configuration is adopted, it will be unnecessary to form a convergence electrode plate individually for

every segment, and the photomultiplier tube which is easy to assemble will become possible. By furthermore, the thing positively established for opening between a dashboard and a convergence electrode plate The source of vacuum evaporationo required of the photoelectric-surface formation process at the time of assembling the photomultiplier tube for photoelectric-surface formation Only by (for example, being able to arrange an antimony bead, a manganese bead, etc.) to this opening, and not arranging the source of vacuum evaporationo for every segment, but ** arranging the necessary minimum source of vacuum evaporationo in electronic convergence space It becomes possible to form the photoelectric surface in the steam for photoelectric-surface formation at homogeneity based on a spreading effect.

[0008] In the photomultiplier tube according to claim 2, the foot insertion section is desirable in their being a slit or a hole. When such a configuration is adopted, the non-contact condition of the fixed electrode plate and dashboard between which the leg was made to be placed can be attained simply and certainly.

[0009] In the photomultiplier tube according to claim 3, in the opening department of a dashboard, when the source of vacuum evaporationo for photoelectric-surface formation to just under a dashboard is arranged, it is desirable. When such a configuration is adopted, homogeneity will be reached to the photoelectric surface, without being interfered with the steam generated from the source of vacuum evaporationo for photoelectric-surface formation by the dashboard, and it contributes to formation of the homogeneous photoelectric surface.

[0010] In a photo-multiplier according to claim 4, when antimony BISU of the sources of vacuum evaporationo is arranged to a part for the intersection of a dashboard, to it, it is desirable. Such a configuration is a mode very desirable when forming the homogeneous photoelectric surface.

[0011]

[Embodiment of the Invention] Hereafter, the suitable operation gestalt of the photomultiplier tube by this invention is explained to a detail with a drawing.

[0012] Drawing 1 is the sectional view of the photomultiplier tube concerning this invention. The photo-multiplier 1 shown in this drawing has the transparence glass hollow bulb 2 which makes the shape of the square pole, welding immobilization of the glass optical entrance window 3 is carried out, and welding immobilization of the glass stem 5 which fixed the stem pin 4 to the other end of a bulb 2 annularly is carried out at the end of this bulb 2. And the vacuum housing 6 consists of a bulb 2, an optical entrance window 3, and a stem 5.

[0013] As shown in drawing 1 and drawing 2, the electronic multiplication object 7 is arranged in a vacuum housing 6, the convergence electrode plate 8 is fixed to the upper limit of the electronic multiplication object 7, and the electronic convergence space S (refer to drawing 4) is formed between this convergence electrode plate 8 and the optical entrance window 3. This electronic convergence space S is the space for carrying out incidence certainly into the electronic multiplication object 7, completing the electron emitted from the optical entrance window 3 according to an operation of the convergence electrode plate 8. The cross-like dashboard 9 is arranged in this electronic convergence space S, and this dashboard 9 is dividing the inside of the electronic convergence space S into four segments. And with this dashboard 9, the photoelectric surface 10 formed inside the optical entrance window 3 was quadrisected, and the four multiplication sections 11 are formed in the electronic multiplication object 7 corresponding to it. Furthermore, it connects with a stem pin 4 electrically through wiring 12, and each multiplication section 11 starts each wiring 12 from each stem pin 4, it is making the electronic multiplication object 7 fix to wiring 12, and the electronic multiplication object 7 will be held at the position within a vacuum housing 6.

[0014] When each part article of such the photomultiplier tube 1 is explained further in full detail, the electronic multiplication object 7 is inserting each dynode D with the side plate 13 of four sheets, constitutes the four multiplication sections 11, and makes two or more steps of electronic multiplication functions attain in each multiplication section 11, as shown in drawing 3. Moreover, in the convergence electrode plate 8, the starting edge 14 which bends the sheet metal of one sheet and is made by processing or carrying out press working of sheet metal is established in the periphery of body of convergence electrode plate 14A which makes an abbreviation square-like plate. Furthermore, corresponding to each multiplication section 11, four electronic entrance windows 15 are formed in body of convergence electrode plate 14A. And attachment immobilization of the convergence electrode plate 8 to the electronic multiplication object 7 makes the protruding piece 16 prepared at the tip of the side plate 13 of the electronic multiplication object 7 insert into the opening 17 formed in the convergence electrode plate 8, and is made to attain by driving in the piece 19 of a wedge in the notch 18 for plugs prepared in the lower limit of a protruding piece 16.

[0015] The inside of the optical entrance window 3 quadrisects the photoelectric surface 10 so that each segment may be made to correspond, four photoelectric-surfaces partial 4a is made, and each photoelectric-surface partial 4a has become a concave lens configuration. On the other hand, by carrying out fitting through the slit section K (referring to drawing 4), a dashboard 9 is formed in a cross, and it is arranged so that four photoelectric-surfaces partial 4a may be divided, so that piece of batch 9A and dashboard 9B which make an abbreviation same configuration may be made to intersect

perpendicularly. Moreover, the crowning of each pieces 9A and 9B of a batch is incurvated corresponding to the boundary line L of the cross configuration which divides each photoelectric-surface partial 4a in the photoelectric surface 10 (refer to drawing 3).

[0016] Moreover, the leg 20 was formed in one, respectively and the four legs 20 are formed in the both ends of each pieces 9A and 9B of a batch at the cross-like dashboard 9. And by each leg 20, a dashboard 9 and the convergence electrode plate 8 are made to estrange, and Opening P is formed there (refer to drawing 1).

[0017] Moreover, the electric flow with a dashboard 9 and the convergence electrode plate 8 is made to avoid. Concretely, as shown in drawing 3 - drawing 5 , the slit 21 as the foot insertion section which makes the leg 20 penetrate is cut deeply and formed in the convergence electrode plate 8. Moreover, the slit 21 has the slitting width of face which cannot touch the leg 20 from the need that the leg 20 is in a non-contact condition as electrically as the convergence electrode plate 8. Furthermore, the fixed electrode plate 22 which the side plate 13 was made to fix to the convergence electrode plate 8 bottom is arranged, and the tip of the leg 20 of a dashboard 9 is made to fix to this fixed electrode plate 22.

[0018] Moreover, the fixed electrode plate 22 needs making it flow electrically with a dashboard 9 through the leg 20. So, four notches 23 as a foot fixed part for carrying out insertion immobilization of the tip of each leg 20 are formed in the fixed electrode plate 22. And after making the tip of the leg 20 insert in each notch 23, respectively and bending point 20a of the leg 20 in the shape of L character, immobilization of the dashboard 9 to the fixed electrode plate 22 is attained by carrying out spot welding of this point 20a and the fixed electrode plate 22.

[0019] Moreover, the fixed electrode plate 22 constitutes two piece housing from the 1st fixed electrode plate 22a which makes the shape of U character, and the 2nd fixed electrode plate 22b which makes the shape of a straight line. Then, immobilization of the fixed electrode plate 22 to the electronic multiplication object 7 is attained by inserting 1st fixed electrode plate 22a and 2nd fixed electrode plate 22b from an outside, respectively in each notch 24 for plugs prepared in the side plate 13 of the electronic multiplication object 7, and carrying out spot welding of the part for the joint of 1st fixed electrode plate 22a and 2nd fixed electrode plate 22b.

[0020] In addition, the piece 25 of a spring of the shape of a pawl made to contact the internal surface of a bulb 2 is being fixed to the periphery of this fixed electrode plate 22 by spot welding. Moreover, the lower limit of the electronic multiplication object 7 is covered with the shielding plate 26. And the aluminum thin film A in contact with the photoelectric surface 10 is formed in the internal surface of the upper part of a bulb 2. Therefore, the photoelectric surface 10 and a dashboard 9 are made into this potential by contacting the piece 25 of a spring to the aluminum thin film A.

[0021] Thus, the photomultiplier tube 1 has the dashboard 9 of a cross to the electronic convergence space S between the optical entrance window 3 and the electronic multiplication object 7, and a dashboard 9 and the four multiplication sections 11 divide the interior of the photomultiplier tube 1 into four segments. Such the photomultiplier tube 1 is called the photomultiplier tube of 4 segmental dies, makes it possible to carry out multiplication of the electron for every segment, and is aiming at improvement in the indexing precision of the location of the radiation sources, such as an X-ray and a gamma ray. Moreover, the convergence electrode plate 8 is not individually formed for every segment, but also makes possible the photomultiplier tube 1 which is easy to assemble. Furthermore, by forming Opening P positively between a dashboard 8 and the convergence electrode plate 8, in case the photomultiplier tube 1 is assembled, the sources 28 of vacuum evaporation for photoelectric-surface formation (for example, an antimony bead, a manganese bead, etc.) which are needed with a photoelectric-surface formation process can be arranged to this opening P.

[0022] Concretely, as shown in drawing 5 and drawing 6 , the source 28 of vacuum evaporation for photoelectric-surface formation to just under piece of batch 9B is arranged, and this source 28 of vacuum evaporation consists of antimony bead 28a and manganese bead 28b. It is fixed to the lead wire 31 prolonged from the hermetic sealing 30 made to fix to the convergence electrode plate 8, and these BISU 28a and 28b is arranged in Opening P. Here, antimony BISU 28a is arranged just under the location where it crosses, parts for Intersection 9A and 9B, i.e., the pieces of a batch, of the convergence plate 9, and is arranging manganese BISU 28b on both sides of this antimony BISU 28a.

[0023] thus, by forming Opening P in the electronic convergence space S positively, the source 28 of vacuum evaporation is not arranged for every segment, but ** also arranges the necessary minimum beads 28a and 28b in the electronic convergence space S -- being sufficient . And a bead steam generates a current by making a sink and Beads 28a and 28b heat in lead wire 31, and uniform formation of the photoelectric surface 10 is enabled based on diffusion of this steam. Moreover, it is very desirable to arrange antimony BISU 28a just under the location where the pieces 9A and 9B of a batch cross, when forming the homogeneous photoelectric surface 10.

[0024] Here, as other operation gestalten of the photomultiplier tube 1 of this invention, as shown in drawing 7 ,

welding immobilization of the rod-like leg 34 is carried out at the dashboard 33 which consists of the 1st piece of batch 33A, and the 2nd piece of batch 33B. Moreover, in the convergence electrode plate 8, the hole 35 as the foot insertion section in which each leg 34 is made to insert in the state of non-contact is formed in body of convergence electrode plate 14A. And four holes 36 as a foot fixed part for carrying out insertion immobilization of the tip of each leg 34 are formed in the fixed electrode plate 22. Then, after making the tip of the leg 34 insert in each hole 36, respectively and bending point 34a of the leg 34 in the shape of L character, immobilization of the dashboard 33 to the fixed electrode plate 22 is made to attain by welding this point 34a and the fixed electrode plate 22. In addition, in drawing 7, the same sign is given to a component the same as that of drawing 3, or equivalent, and the explanation is omitted.

[0025] This invention is not limited to the operation gestalt mentioned above, and in the case of the photomultiplier tube 40 of 3 segmental dies, a dashboard 41 is constituted by the parallel pieces 41A and 41B of a batch of two sheets not crossing as shown in drawing 8. And just under each pieces 41A and 41B of a batch, antimony BISU28a and manganese BISU 28b are arranged, respectively.

[0026] Moreover, in the case of the photomultiplier tube 50 of 8 segmental dies, a dashboard 51 is constituted by the pieces 51A, 51B, and 51c of a batch of three parallel sheets prolonged horizontally, and piece of batch 51D of one sheet perpendicularly prolonged so that these might be intersected as shown in drawing 9. And the source 28 of vacuum evaporation is arranged just under piece of batch 51D. In this case, antimony BISU 28a and manganese BISU 28b are arranged with respectively sufficient balance so that it may become the symmetric relation on the basis of the center position O of a dashboard 51. That is, since a center position O is also the core of the photoelectric surface 10, it can make homogeneity diffuse a BISU steam in the electronic convergence space S by arranging antimony BISU 28a and manganese BISU 28b with sufficient balance in the location which becomes symmetrical centering on this location O.

[0027] In addition, irrespective of the number of segments, it is important to arrange the source 28 of vacuum evaporation with sufficient balance on the basis of the center position O of the photoelectric surface 10, when forming the photoelectric surface 10, and the source 28 of vacuum evaporation does not necessarily need to be just under a dashboard. Moreover, the source of vacuum evaporation may be prepared for every segment.

[0028]

[Effect of the Invention] Since the photomultiplier tube by this invention is constituted as mentioned above, it acquires the following effectiveness. Namely, opening which a dashboard is formed [opening] caudad and makes between the adjoining segments open for free passage in electronic convergence space, The leg over which it was built between the fixed electrode plate made to fix to an electronic multiplication object, and a dashboard and a fixed electrode plate, By having made it fix to an electronic multiplication object, having been prepared in the convergence electrode plate arranged between the fixed electrode plate and the dashboard, and the convergence electrode plate, and having had the foot insertion section which makes the leg penetrate in the state of non-contact, structure is easy and the photomultiplier tube which components mark tend to assemble few is made possible.

[Translation done.]

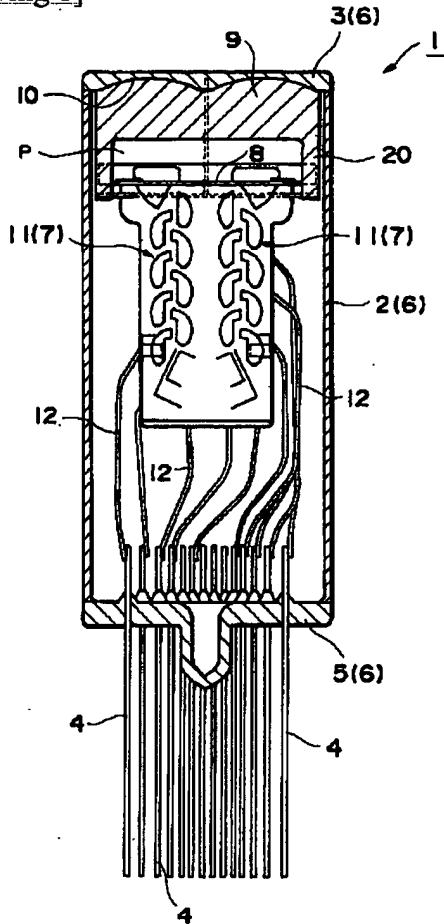
* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

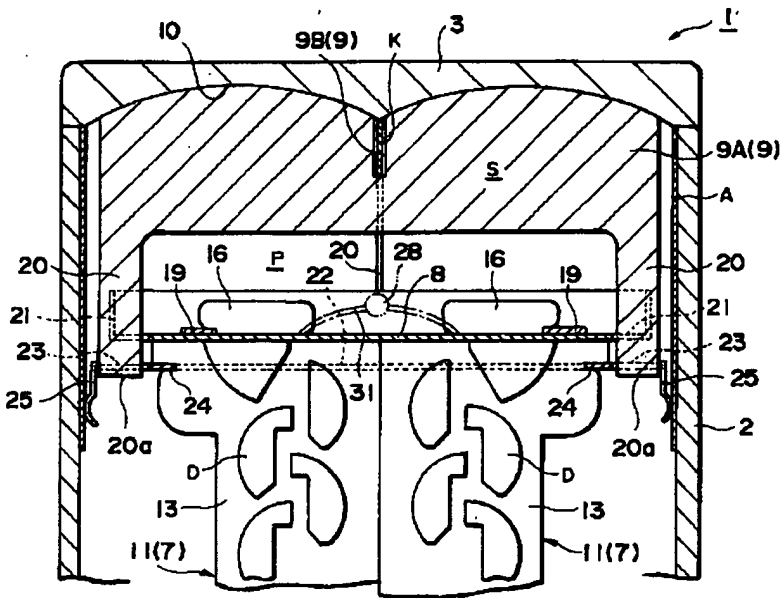
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

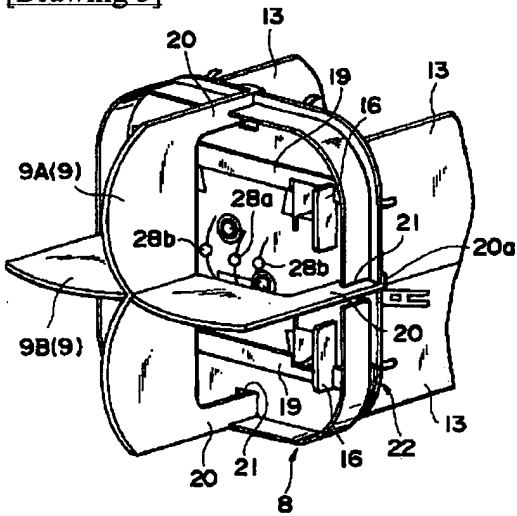
[Drawing 1]



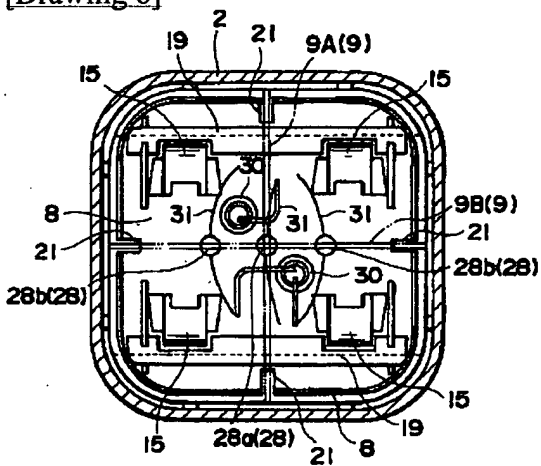
[Drawing 4]



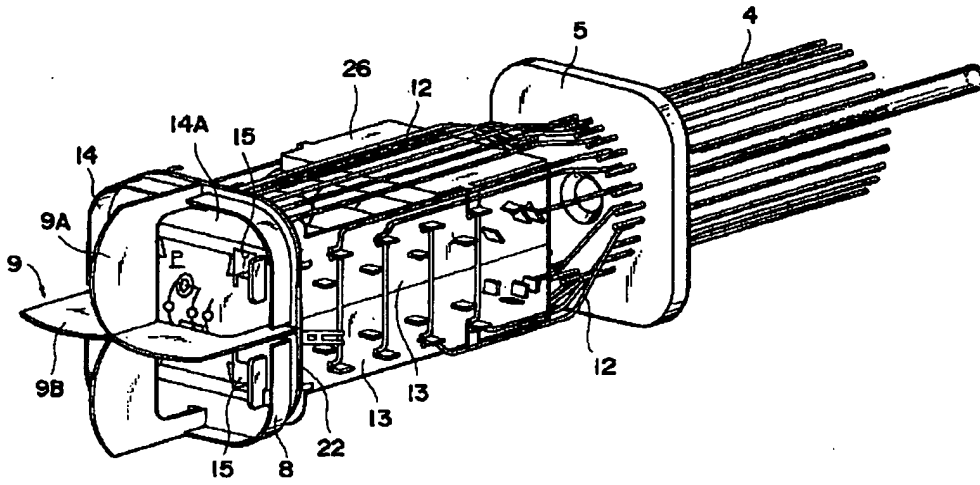
[Drawing 5]



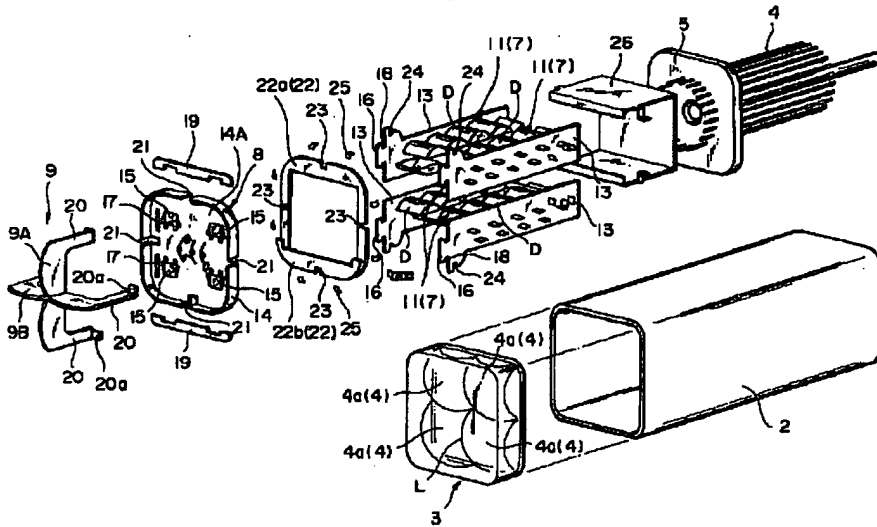
[Drawing 6]



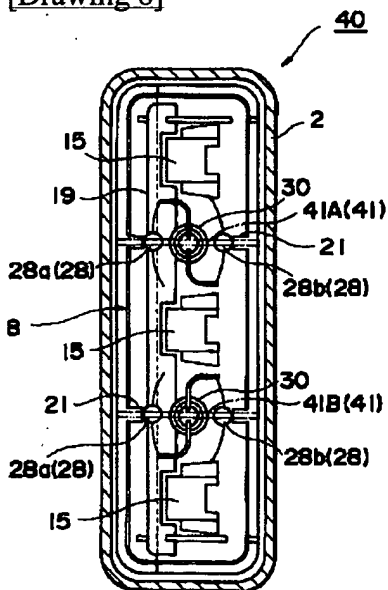
[Drawing 2]



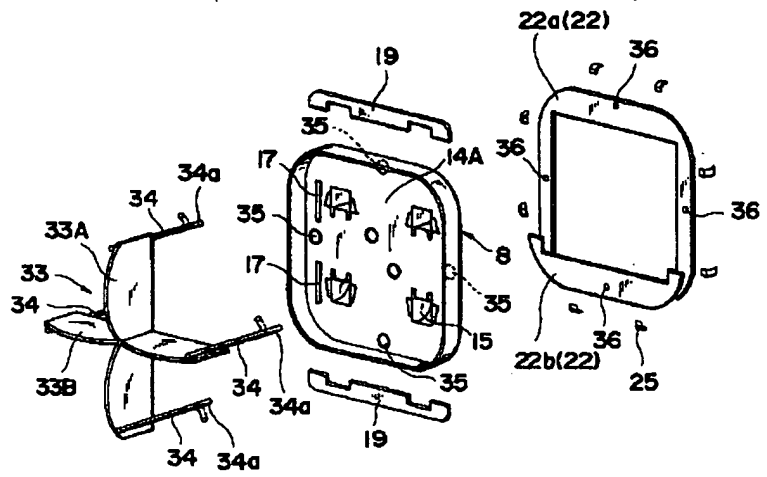
[Drawing 3]



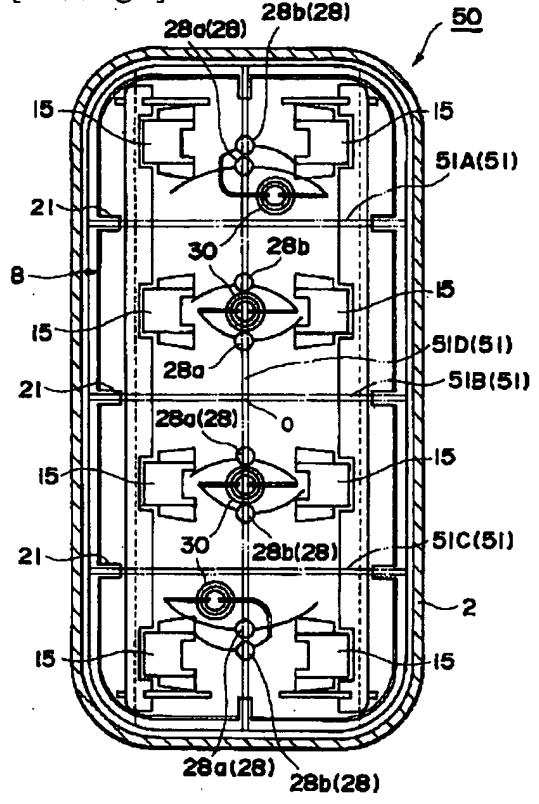
[Drawing 8]



[Drawing 7]



[Drawing 9]



[Translation done.]